REMARKS

It is noted that the claim amendments herein are intended solely to more particularly point out the present invention for the Examiner, and not for distinguishing over the prior art or the statutory requirements directed to patentability.

It is further noted that, notwithstanding any claim amendments made herein, Applicant's intent is to encompass equivalents of all claim elements, even if amended herein or later during prosecution.

Claims 1 and 4-17 are all of the claims pending in the present Application. New claims 16 and 17 are added. Claims 1, 4-6, 9, and 15 stand rejected under 35 USC §102(e) as anticipated by US Patent 5,959,307 to Nakamura et al. Claims 7, 8 and 10-14 stand rejected under 35 USC §102(e) as anticipated by Nakamura or, alternatively, as rejected under 35 USC §103(a) as being unpatentable over Nakamura.

These rejections are respectfully traversed in view of the following discussion.

I. The Claimed Invention

As described and claimed, for example by claim 1, the present invention is directed to a group III nitride compound semiconductor light-emitting device including a light-emitting layer of a multilayer quantum well structure including alternately laminated well layers and barrier layers and an n-type clad layer being in contact with the light-emitting layer. The n-type clad layer is made thicker than each of the barrier layers and the thickness of the n-type clad layer is in a range of 100 Å to 500 Å. The n-type clad layer is formed of a material substantially the same as the barrier layers, thereby providing a band gap in the n-type clad layer that is substantially the same as a band gap in the barrier layers.

With such unique and unobvious features, high light intensity is provided by securing the effect of confining carriers sufficiently in the light-emitting layer while keeping color purity intact.

II. The Prior Art Rejections

The Examiner alleges that US Patent 5,959,307 to Nakamura et al anticipates or renders obvious the present invention as described by claims 1 and 4-7. However, Applicants respectfully disagree.

A key feature of the present invention, as defined by claim 1, is that, as described by lines 3-5 of page 9 of the specification, the barrier layers and n-type clad layer are made of substantially the same material, by reason that the barrier layers are formed using "the same condition as used for forming the n-type clad layer".

Based on the Examiner's concerns that the statement contradicts earlier statements in the file, Applicants hereby retract the statement on page 4 of the Preliminary Amendment filed January 16, 2003, that doping is identical in the barrier layers and n-type clad layer.

However, as the Examiner points out on page 4 of the Office Action dated February 11, 2003, it is the composition of the layer, rather than doping, that defines band gap.

However, Applicants again dispute that Nakamura in any way suggests to use the same material for the barrier layers as for the n-type clad layer adjacent to the active layer, as well as for the cap layer adjacent to the p-type clad layer (see claim 9).

This feature of the present invention in which the barrier layer and n-type clad are the same material provides colorimetric purity of the emitted light. If the barrier layer and n-type clad differ in material, then the lattice constants of these layers will also differ.

It makes a difference between the strain imposed on the lowermost well layer adjacent to the n-clad layer and the strain on the other well layers. As shown in Figure 1 of the present Application, there are three well layers 161, and the quantum level of the lowermost well layer differs from that of other layers. Each of the well layers respectively emits light, but the color of the light (wavelength) from the lowermost well layer would differ from light emitted from the other two layers due to the difference of the strain, if strain were not matched, since it is known that such strain affects the quantum level of the layer.

That is, only the lowermost well layer among the three well layers is adjacent to the n-clad layer on one side opposite to the barrier layer. Accordingly, if the n-clad layer is made of different material from the barrier layer, then the quantum level state on respective sides of the

lowermost well layer would be asymmetric, thereby affecting the quantum level of the well layer itself, which exists between two layers.

The total light is a mixture of the three light emissions from the three respective light well layers. Accordingly, colorimetric purity of the total light is deteriorated if the n-clad layer is made from material different from that of the barrier layer.

In contrast, in the present invention, substantially the same material is used for the barrier and n-type clad, thereby making equal the strain on each well layer and making symmetric the quantum level on both sides of the lowermost well. As a result, colorimetric purity of the total light can be maintained in the present invention. No such feature of the n type cladding layer and the barrier layers being formed of substantially the same material is suggested in Nakamura.

As previously pointed out by Applicants, MPEP 2143.01 clearly states, citing *In re Mills*, 916 F.2d 680, 16 USPQ 2d 1430 (Fed. Cir. 1990), that "the mere fact that references can be combined or modified does not render the resultant combination obvious unless the prior art also suggests the desirability of the combination" (emphasis in MPEP).

In order to modify Nakamura to be configured as defined in independent claims 1 and 15, one of ordinary skill would begin by noting that Figure 2 shows that light guiding layer 15 is adjacent to active layer 16. Layer 14 is described as being an n-type carrier confinement layer. In the second embodiment shown in Figure 3 and the third embodiment shown in Figure 4, these two layers 15, 16 become 201 and 202, respectively. In several examples, layer 201 is eliminated.

Therefore, disregarding, for the sake of argument, the labeling differences in Nakamura, in order satisfy the independent claims in which the clad layer must contact the active layer, at least one of layers 14, 15, 201, or 202 would have to be made of " a material substantially the same" as the barrier layers.

As the Examiner points out on page 4 of the latest Office Action, assuming *arguendo* that doping is not substantially affecting band gap, then the composition of the barrier layer would have to be essentially identical to that of at least one of these layers 14, 15, 201, 202.

However, nowhere does Nakamura make this suggestion.

That is, one of ordinary skill would consider that Nakamura makes it clear that at least

two features are essential. First, the device relies on a plurality of layers for confinement (see Abstract). The Examiner relies heavily on this feature for the rejection currently of record. Second, as described at lines 28-58 of column 12, the well layer must have a specific structure for a lower threshold current and higher temperature characteristic.

According to lines 4-13 of column 6, the well layer in Nakamura is formed of $In_dAl_eGa_{1-d-e}N$ ($0 < d \leq 1$, $0 \leq e \leq 1$, $0 < d+e \leq 1$). At lines 9-13 of column 6, Nakamura states that $In_fG_{1-f}N$ ($0 < f < 1$) is preferred as the well layer.

Nakamura does not express any specific concern for the barrier layers except that, as described by lines 16-18 of column 6, they have a larger band gap energy than that of the well layers. At lines 28-39 of column 6, Nakamura states that the barrier layer material can be GaN, AlGaN, or the like, but that "it is particularly preferred that the barrier layer be formed of ternary mixed crystal $In_{f'}Ga_{1-f}N$ ($0 < f < 1$ providing $f' < f$) as in the case of the well layer."

Nowhere does Nakamura even hint at a suggestion that the barrier be related in any way with any of layers 14, 15, 201, 202.

Indeed, in order to modify Nakamura, one of ordinary skill in the art would have to overcome the above-discussed key features and preferences that are explicitly taught in the reference itself.

Thus, in order to modify the first, second, or third embodiments to meet the clear recitations of the independent claims 1 and 15, an analysis would have to begin by considering that Nakamura expressly teaches that the barrier is InGaN, and then one of ordinary skill in the art would have to ask whether there is any suggestion to make layer 14, 15, 201, 202 to also be InGaN.

According to lines 55-63 of column 5, Nakamura expressly teaches that layer 14 is $Al_bGa_{1-b}N$ and layer 15 is "an indium-containing n-type nitride semiconductor or an n-type GaN, i.e., $In_cGa_{1-c}N$." According to lines 14-17 and 47-49 of column 10, layer 201 is similarly AlGaN and layer 202 is similarly either GaN or InGaN for the second embodiment and, presumably, the third embodiment.

In Examples 1-3, the barrier layer is non-doped $In_{0.01}Ga_{0.99}N$ (see column 14 at line 47), layer 201 is Si-doped $Al_{0.1}Ga_{0.9}N$ (see column 14 at line 39), and layer 202 is Si-doped n-type GaN (see column 14 at line 35). Example 4 contains no barrier layer. In Example 5,

layer 202 is Si-doped n-type $In_{0.01}$ $Ga_{0.99}N$ (see column 16 at line 26). Examples 6-8 contain barrier layer of example 1 except that the barrier is doped.

In Examples 9-11 and 13-15, the barrier layer is non-doped $In_{0.1}$ $Ga_{0.9}N$ (see column 17 at line 22), layer 14 is Si-doped $Al_{0.3}Ga_{0.7}N$ (see column 17 at line 12), and layer 15 is Si-doped n-type GaN (see column 17 at line 15). In Example 12, layer 14 is Si-doped $In_{0.05}Ga_{0.95}N$ (see column 18 at line 21).

From the above, the closest that Nakamura approaches the present invention, as defined by claims 1 and 15, is Example 5 wherein both the barrier layer and layer 202 are made of $In_{0.01}$ $Ga_{0.99}N$. But in Example 5, layer 202 is not in contact with the active layer.

That is, in Nakamura, there is no teaching or suggestion in the discussion for the three embodiments, nor are there any examples that teach or suggest that the same material be used for both the barrier and layer 14, 15, 201, 202.

Additionally, the energy band diagram shown in Figure 5 clearly shows that no band gaps are expected in Nakamura to be substantially equal to that of the barrier layer, let alone that the barrier layer and n-type clad layer specifically have substantially the same band gap.

Hence, turning to the clear language of the claims, there is no teaching or suggestion that " ... said n-type clad layer is formed of a material substantially the same as said barrier layers, thereby providing a band gap in said n-type clad layer that is substantially the same as a band gap in said barrier layers."

Moreover, relative to claims 7 and 16, it can only be said that Nakamura actually teaches away from using GaN as the barrier.

Finally, relative to claims 9 and 17, the present invention has a unique structure in which the same material is used not only for the barrier layers and the n-type clad layer contacting the well layer but is also used for a cap layer contacting the other side of the active layer.

For the reasons stated above, the claimed invention is fully patentable over the cited reference.

Further, the other prior art of record has been reviewed, but it too even in combination with the Nakamura reference, fails to teach or suggest the claimed invention.

III. Formal matters and Conclusion

In view of the foregoing, Applicant submits that claims 1 and 4-17, all the claims presently pending in the application, are patentably distinct over the prior art of record and are in condition for allowance. The Examiner is respectfully requested to pass the above application to issue at the earliest possible time.

Should the Examiner find the application to be other than in condition for allowance, the Examiner is requested to contact the undersigned at the local telephone number listed below to discuss any other changes deemed necessary in a telephonic or personal interview.

The Commissioner is hereby authorized to charge any deficiency in fees or to credit any overpayment in fees to Attorney's Deposit Account No. 50-0481.

Respectfully Submitted,

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